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ABSTRACT

Project City Science, funded by the National Science Foundation, is designed by the New York University as an urban systems approach to the improvement of intermediate science teaching in New York City. This report consists of three major sections. The first section describes the preservice program, which includes courses presented, school involvement, and New York City License Exams. The second section describes the Model Districts Program. Science activities which show the curricular adaptation efforts, field trips, special projects, and the role of the coordinator are included. The third section describes the research program and efforts of the research team. This includes the presentation of research papers. An introduction and a sample of the instructional materials are also included. (HM)

P R O J E C T

C I T Y

S C I E N C E

Funded by the National Science Foundation

PROGRESS REPORT #16

January 1, 1979 to May 31, 1979

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PROJECT CITY SCIENCE

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P R O J E C T C I T Y S C I E N C E

An urban systems approach to the improvement of intermediate science teaching in New York City

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PROGRESS REPORT #15

January 1, 1979 to May 31, 1979

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INTRODUCTION

With the funding of the Project by NSF scheduled to terminate on August 31, 1979, continuity of the Project, staffing for 1979-80, placement of departing staff, and preparations for next year have been of major concern. Because a small sum, perhaps $30,000 beyond that allocated for the final report, will be available, we requested and received an one-year extension, without additional funds, from the NSF. These carry-over funds have been used to guarantee the salary of Judith Klein for 1979-80 irrespective of any other income for the Project. Thus the central staff of Klein, Connor and Watson has been assured for the year ahead.

Continued negotiations with the Board of Education of the City of New York have led us to expect significant financial support from "tax levy" money to meet more than half the budget. The remainder would be provided by six Districts each of which would have two interns in each of two schools. Coordinators would be school personnel released half-time to work with the interns and to be students at New York University. In response to our inquiries, numerous Districts have indicated a strong desire to have the Project functioning in their schools. Delays in formal approval of the budget of the City have prevented negotiations of official contracts

with the City and the Districts, but fiscal arrangements are expected to be completed early in the summer.

The unwillingness of NYU to provide a minimum staff on academic appointment to meet responsibilities to both Project students and matriculated doctoral students threatens the long term continuity of the Project. Because operation of the Project requires a knowledge of and close working relations with the schools, continuity of the teaching staff is essential.

On April 1, Dr. Theresa Jordan left the Project to assume a three-year appointment as research director for another New York University project. However, with her usual kindness, she continues to provide advice on particulars of our research operations.

Under a separate NSF contract nearby Queens College has been making an external evaluation of Project City Science. Two reports, as of July 1978 and of April 1979, have been submitted. Considerable time of Project staff members has gone into reactions and clarifications of items in these reports. The effort by the Queens group dramatizes the considerable difficulties of having an external group attempt a continuing appraisal of a project operating in its fourth and fifth years. Because the Project has a small staff and major commitment to school-based training of intern teachers,

many interesting possibilities for action and research suggested in the early days of the Project have been impossible to implement.

With a relatively mature and highly committed group of interns, the academic year 1978-79 has been quite successful and approximated the training model envisioned.

From its inception the Project has sought to recruit interns from minority groups, especially Blacks and Hispanics. During the four-year operation of the intern program, fifteen minority members (or twenty-six percent) were among the fifty-four completing the program.

Nationwide, the number of minority students majoring in the sciences is pathetically small. According to the Manpower Survey, in 1975-76 less than five percent of all graduating science majors were minority members. Biology had 3,100 (6.2%), chemistry had 330 (3.3%), physics had 67 (1.5%), and earth science had 38 (0.8%). That twenty-six percent of the Project interns have been minority members is encouraging.

Unexpected consequences of the Project operation have been occurring. After our presentations at NSTA, representatives of the Department of Education in Puerto Rico requested that the staff organize and operate a teacher development program on that island. This was a natural extension of the

long-term cooperation between the Department of Education and New York University. However, no course offerings for science teachers had been made for nearly a decade. Throughout this past academic year Connor and Klein have shared alternate fortnightly presentations of day-long adaptations of two of the basic courses presented to Project interns. The class of thirty teachers, who were seeking up-dating on science and pedagogy, came from all parts of the island. Connor had been able to raise $9,000 in scholarship funds from a number of industries on the island. The funds provided year-long half-tuition scholarships for eighteen teachers and supervisors. The others came at their own expense. Upon initial announcement of the program, one hundred and seven teachers came to San Juan for interviews last September. Clearly there is much interest among the teachers and a willingness by many to pay at least half of their own tuition, as well as travel expenses. Additional scholarship funds are being sought with the intent of maintaining a continuing program which would lead to a master's degree at NYU.

A further consequence of the activities in Puerto Rico was an invitation to Connor to join an international discussion of science education held in the Barbados mainly for representatives of Caribbean schools.

Further curiosity about the Project has led to an in-

vitation to Watson to discuss the Project in Winnipeg next October at the annual convention of the Science Teachers' Association of Manitoba (STAM).

PRESERVICE PROGRAM

For preservice students, the start of the spring semester marked the beginning of a shift in responsibilities, from heavy course work to increasingly greater teacher loads in the schools. The semester also included the introduction of two new courses: Education for an Ecological Society, which is an extension of the Urban Ecology course presented in the fall, and Implementation of Intermediate School Science Programs, a course built around the themes of change, curriculum and community. Finally, preservice students were involved in taking New York City License examinations. This was the first time that these tests had been given during the life of the Project.

Courses

Two new courses were developed during the preceding summer in partial response to the suggestions made by the preservice of 1977-78. At that time, the difficulties with the courses in Integrated Science were highlighted, and the decision was made to replace them with Urban Ecology (fall semester) and Education for an Ecological Society (spring semester). These courses were designed to focus on ecological principles and their application to the schools, while re-

taining an integrated science orientation. Further discussion of this decision is found in Progress Report No. 14, pp. 2-3. In addition, these changes reflected the continuing attempts of the staff to provide greater cohesiveness between course work and students' school experiences. Thus, the Implementation course was designed to replace the troublesome Sociology offering. It retained the intensive community involvement of the Sociology course, while adding emphasis in areas more pertinent to students' primary responsibility.

Education for an Ecological Society

During the spring semester the second part of the urban ecology curriculum, Education for an Ecological Society, was presented. This was the first time this course has been taught. The course content was an outgrowth of earlier course evaluations which indicated that more educational content was required in preservice training. Consequently, the course focused on the ways that environmental concepts encountered in the fall course, Dynamics of Urban Ecology, could be taught to adolescent learners.

The objectives of the course were to allow and encourage students to use topics from urban ecology as part of a junior high school science program, to develop a variety of learning activities (hands-on, audio visual support mate-

rials, field trips, etc.) appropriate to environmental education, to construct and implement a complete unit plan for environmental education in schools where they were student teachers. Examples of environmental units developed under the course auspices included "Symbiosis in the City" and "Energy Waste at School." Examples of audio visual support materials included an electric bulletin board that beckoned student participation and a slide-tape presentation on city trees. Field trips included an investigation of a nearby beach community, a trip to a solar house, and a look at various architectural styles. Examples of hands-on activities included the building of mini-windmills, classroom gardening, and a measure of air pollution with very simple apparatus.

The course was well received by the preservice interns. Each was able to implement environmental activities in his or her student teaching, some more than others. In addition, they received feedback on those activities as a regular part of the course.

A course package for the urban ecology curriculum was developed. It contains an overview and sample materials for both Dynamics of Urban Ecology and Education for an Ecological Society. The course is available upon request from Project City Science.

Implementation of Intermedi te School Science

This course was developed aroun i three general foci: curriculum, change and communit '. In general, the course was loosely structured in order to allow each student to identify needs in each of these areas related directly to his/her own specific school situation. Activities in the course grew out of students' attempts to devise solutions to meet these needs, report on the attempted solutions and evaluate their effectiveness. In order to support this structure, each student drew up a contract which specified the means by which these goals would be attained and a time frame for their achievement. Although contracts were written up early in the course, our experience clearly demonstrated the desirability of having students modify and augment their original plans in response to the reality of the schools. As students became more responsible for implementing the decisions that they made, they also recognized that what looks good on paper is often not feasible given the time, personnel and other resources available to the classroom teacher. For most of the students, two tangible products resulted from the course: curriculum, change and community projects which had direct applicability to their current school placements, and the knowledge that they as classroom

teachers could substantially modify a given curriculum and portions of the school environment to bring about more effective educational experiences for their students.

School Involvement

As soon as students returned from the semester break, they began the process of identifying another teacher with whom they could pick up their second class. The goal was to assume responsibility for a second class by mid-February, add a third (preferably with yet another teacher) by about the third week in March, and finally, add a fourth class to their teaching loads after the spring recess (last week in April). Our purpose was not only to provide each student with experiences with pupils at different levels of academic ability, grades and in different science content areas, but also to involve many teachers who previously had worked with the Project only tangentially. In addition, it was anticipated that teaching four periods per day would approximate the work load that students would encounter if they accepted jobs in the city system in the fall.

Although many preservice students assumed at least partial responsibility for third and fourth classes, there were many problems. Students and their cooperating teachers complained that the teaching (and planning) load was onerous.

Some teachers were reluctant to provide classes for only a few weeks, late in the school year. Also, it was sometimes difficult to find appropriate classes in other teachers' programs that would fit into the existing patterns of classes already taught by the preservice.

Despite their heavy teaching responsibilities, students participated in the planning and development of many science related activities. City resources were used to better advantage than previously, resulting in field trips for their students to the Bronx Botanical Garden, Wave Hill Environmental Center, the Breezy Point Unit of Gateway National Park, the Brooklyn Botanical Garden and Pelham Bay Park, as well as short trips to neighborhood parks, local pet stores and tours of school heating plants among others. As in the past, Project interns played prominent roles in the Science Fairs of their schools, especially working with individuals and small groups of pupils on the development of their Science Fair Projects. Finally, preservice students initiated a number of special projects in the schools, among which were: a school-wide science newsletter, the design and construction of a rooftop weather station, the organization of a weather watcher's club, a solar eclipse viewing, using pin-hole cameras and similar devices, and lab squads to organize, distribute and collect laboratory materials from the science

teachers in several of the schools.

One of the features that perhaps sets this preservice program apart from usual student teaching experiences is the opportunity students have to modify existing curriculum and subsequently to implement their adaptations. This process is begun in the fall semester for courses in Curriculum and Methods, and this year for the first time, has continued into the spring semester in the Implementation Course. Because of this emphasis, students are able to accept the demands of intensive teaching with the knowledge that they have already expended the time necessary to identify and sequence activities in a variety of content areas. In addition, continuing our plan from 1977-78, revised copies of these materials have been assembled, copied and placed on file so that they are accessible to all students in the program. In contrast to last year, this scheme to share classroom tested experiences based on the New York City Science Course of Study has worked well. The files consist of some commercially developed materials, but mostly of student adaptations of units or major portions of units, as well as explicit plans for a variety of field trips. The difference this year has been the inclusion of written materials only, and the persistence of the staff in copying materials before they vanished into the schools. What we

have seen this year is the develpemnt of a small but effective curriculum lending library within the Project.

New York City License Exams

For the first time since 1974, New York City offered regular license examinations in junior high school general science and each of the high school science disciplines. With the notable exception of teachers serving on "Per Diem Certificates" (substitute status) the vast majority of junior and senior high teachers in New York City have completed the City's licensing procedure. In the past, the unavailability of these examinations has been a major obstacle to having our graduates obtain permanent teaching positions. Until now, all of them who have taught in New York's schools have been there on temporary credentials (Per Diem Certificates). Initially, this made it more difficult for them to find jobs, and subsequently, it has meant great uncertainty about remaining in a particular school for more than a year.

The license examinations consisted of five parts: written (science subject matter and pedagogy), written English, performance (laboratory tasks in each of four areas), interview, and medical. Each examination, given in parts, was spread over a period of several months. All but two (one

foreign student, one student moving out of state), of this year's group took the license examination in at least one subject. Several students took more than one exam, primarily to insure that they would be licensed. In New York City, it is possible to teach at the intermediate level on a high school license, but not vice versa. Table 1 below shows the number of license examinations taken and passed to date.

TABLE 1

	Biology	*Chemistry*	*Physics*	*Earth Science*	*General Science*	*Other*
No.	4	4	3	1	8	1*

**Mathematics (high school)*

It is anticipated that the City will make appointments of new science teachers for September. We are hopeful that many of this year's graduates will accept positions in New York's intermediate schools.

MODEL DISTRICTS

The focus of the Model Districts Program has always been to create districts "in which the science teaching in the intermediate grades is exemplary in every way." However, in this final semester this task was refined to concentrate on institutionalizing whatever exemplary practices had been developed, so they would endure beyond the period of government funding. To do this the Project staff had to consider what has evolved so far in the program, predict what might be expected to endure in the future, and decide how best to secure its continued maintenance.

What Has Evolved

While the constraints of the school environment -- building, staff, hours, finances, traditions, etc., preclude some innovations, the Project has continually tried new ideas, new approaches, new emphases. During the spring semester, thanks to the further maturation of the coordinators and the fact that the preservice interns began teaching earlier and more intensively, more attempts were made at curriculum adaptation, at community involvement and at changing some aspect of the school environment. In fact, these latter tasks were formalized as goals of the preservice Implementation Course, out-

lined and discussed on p. 9.

As outlined on pp. 22 ff, the activities show that the curricular adaptation efforts of the coordinators resulted in more imaginative modules, more enphasis on marine biology and earth science, and more team teaching efforts. The special projects, especially science fairs, and newspapers were continued, but more through the efforts of the interns and their cooperating teachers, rather than those of the coordinators, as in past years. The coordinator's role focused more on giving workshops that outlined teacher and student responsibilities and organizing the work involved. One particular project that worked very well was the establishment of a weather station by a preservice intern, Ray McGowan. It quickly became the highlight of the homeroom period, at I. S. 142, when the students themselves prepared and gave the report while daily maintaining the station, built by them on the school roof.

The experience of the coordinators over the previous year gave them the expertise and the confidence to better supervise the interns, to better organize the workshops they gave to the inservice teachers and to coordinate the school science activities more effectively, especially where science could be used in the reading programs, the programs for the gifted, etc.

Wide publicity was given the Project when a "Better Reading Through Science" television program (part of Sunrise Semester) involved the associate director commenting on video clips of the students of P. S. 115. They were experimenting with batteries and bulbs, then writing down their experiences for others to read. At the end of the previous school year, the coordinator in this school (P. S. 115), Bob Callan, had written the proposal that funded the program; he was directing the classroom activities. During 1978-79 he held weekly workshops to instruct the sixth grade teachers to do similar activities in their own classrooms.

While their field experiences had given them more confidence, another set of experiences were making increasing demands on the coordinators. This year was the time in their academic careers that most of them began to plan seriously for their doctoral theses, with all the demands this major task would make on their time and energy. Thus it was important to continually reassess what was happening in each school and question what needed to be done to sustain various science activities as the semester was ending. But it was even more important to ask what remained to be done to keep activities going next year when the government funding will be gone.

What Would Remain?

In the attempt to answer their question for next year the focus of the coordinators' activities were different at the university meetings and in the field. They were continually asked to consider what practices had proved most beneficial to good science teaching and how long such practices might be expected to last after the Project was no longer in the schools. While in a few cases teachers' basic content knowledge improved, especially in the areas of physics and earth science, more change could be noted in their skills and attitudes. Since the Project has stressed the "hands-on approach" for individual students in order to bring teachers away from a purely lecture or lecture-demonstration approach, even more time was spent encouraging teachers to use this method. It was hoped that teachers had had enough positive experiences with "hands-on" and that reinforced by their involvement with the preservice interns, they would be encouraged to use the approach increasingly in the future.

But beyond individual teachers in single classrooms, there were the school-wide activities, as the science fairs and the newspapers. While newspapers could be taken over by one teacher and a few students, the science fairs were a much larger managerial and administrative task involving

many teachers, several administrators and hundreds of students. In order that these continue as well planned, effective experiences, the Project staff asked the coordinators to step back and encourage the teachers and administrators to initiate and improve on previous fairs. In most cases things went well at the beginning with the coordinator arranging meetings and workshops to organize the activities and outline the schedule. Then came the problems. Seldom did the school personnel follow up adequately. As a result, too often there was a tremendous rush at the end to have students submit projects in time for the judging. In one instance the fair was postponed and the coordinator blamed for its delay. It took hours of discussion before the school personnel realized that the early workshops wherein they had set their schedule had been forgotten; their complaint then was than they had not been reminded often enough. The happy ending came a month later when the rescheduled fair finally occurred. Despite the problems, the fair was an overwhelming success.

Other attempts to institutionalize the Project occurred naturally in two schools, P.S. 61 in Brooklyn and P. S. 143 in the Bronx. In P. S. 61 the science chairman, Rich Rosenblum, had worked with the Project for four years, had become a doctoral candidate at New York University, and was able to take over the coordinator's role. In P. S. 143, the Assistant

Principal for Science, Ralph Harrison, was also willing to assume coordinator responsibilities. In both instances, problems arose mainly because these coordinators could not be present for the regular staff meetings at NYU, but the attempt was successful in many ways, mainly in giving us directions for the future. Accordingly, when District 15 in Brooklyn asked that P. S. 142 be involved with the Project, we were able to ask that the coordinator, Art Kaufman, be relieved of certain regular school dates so that he could more closely supervise the interns, then attend classes and meetings at the University. This seems to be the model that is most acceptable to district administrators and is most likely to be used by the Project under anticipated City funding.

The promise of continued funding from contributions of the Central Board of Education, cooperating districts and New York University remains in question. Responses to our previous letters show that some twenty districts as well as the Central Board and New York University are definitely interested. However, at the City and district levels, this is a question of financial priority and little can be decided until the New York City budget is settled, sometime in the summer. After that, educational budgets will be decided; after that we will know. Of course, the real problem is that with every day's delay, it becomes more difficult to recruit

qualified interns and coordinators. And the future success of the Project depends on this.

TABLE

Highlights, Project City Science Activities
District 10

Curriculum Adaptation

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Developed unit on electricity and magnetism using "hands-on" activities	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	Joe Sasiela
Adapted unit on batteries and bulbs for Health Conservation class	J. H. S. 141	Marcia Rudy		Sheila Devlin Marion Miller
Designed plant propagation activities for Health Conservation class	J. H. S. 141	Marcia Rudy		Shelia Devlin Marion Miller
Developed a unit on heat and temperature	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	Joe Sasiela
Developed mini unit on living things	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	Joe Sasiela
Developed and taught a sixth grade unit on magnets adapted from ESS's batteries and bulbs	I. S. 115	Robert Callan		Vicki Rusk Kathy Sullivan Marcia Diamond Barbara Harris Henry Eubanks
Developed and taught a seventh grade unit on Electricity	I. S. 115	Robert Callan	Irene Cheteyan	Marie DeCesare

Highlights, Project City Science Activities
District 10

Curriculum Adaptation
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Developed and taught a sixth grade unit on plants and environment	I. S. 115	Robert Callan	Irene Cheteyan	Barbara Harris Simon Libfeld
Developed and taught a sixth grade unit on electricity adapted from ESS's batteries and bulbs	I. S. 115	Robert Callan	Irene Cheteyan	Simon Libfeld
Developed a unit on 7th grade earth science curriculum "Rocks and Minerals" using curricula prepared by Project City Science personnel	I. S. 137	Colin Bradshaw	Lorraine Ling	J. Lippman R. Clunie
Adapted unit on electricity, energy and magnetism using ideas from ESS & SCIS <u>Concepts and Challenges</u> and science activities package	I. S. 137	Colin Bradshaw	Lorraine Ling Ellen Goldstein	J. Lippman R. Clunie J. Kartsch

Highlights, Project City Science Activities
District 10

Curriculum Adaptation
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Adapted unit for study on micro-organisms from SCIS & COPES	I. S. 137	Colin Bradshaw	Lorraine Ling	R. Clunie J. Lippman J. Rosenbluth J. Kartsch
Developed unit on plant growth using ideas from Concepts and Challenges	I. S. 137	Colin Bradshaw	Ellen Goldstein	J. Rosenbluth J. Kartsch
Adapted unit on Mystery Powders to eighth grade chemistry unit	I. S. 137	Colin Bradshaw	Lorraine Ling	J. Lippman
Adapted batteries and bulbs activity to seventh grade physics sequence on electricity	I. S. 137	Colin Bradshaw	Lorraine Ling	R. Clunie J. Lippman

Highlights, Project City Science Activities
District 10

Curriculum Adaptation
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Developed activities on force and energy using ideas from COPES in eighth grade physics unit	I. S. 137	Colin Bradshaw	Ellen Goldstein	J. Kartsch
Developed activities for seventh grade unit of solids, liquids and gases using ideas from <u>Concepts and Challenges</u> and ESS	I. S. 137	Colin Bradshaw	Ellen Goldstein	J. Kartsch
Developed unit on effects of environmental changes on plant growth. Ideas were used from COPES and <u>Concepts and Challenges</u>	I. S. 137	Colin Bradshaw	Lorraine Ling Ellen Goldstein	R. Clunie J. Rosenbluth

Highlights, Project City Science Activities
District 10

Field Trips

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Accompanied class to NY Botanical Garden for 2 session mini-course for 7th graders "Making sense of your environment"	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	Joe Sasiela
Accompanied 8th grade class to NY Botanical Garden tour of conservatory	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	Roberta Fox
Accompanied class to Wavehill Environmental center for program on city trees for 7th graders	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	Joe Sasiela
Arranged field trip to Wavehill Environmental Center for 9th grade	J. H. S. 141	Marcia Rudy		Jay Norwood
Accompanied students on tour of neighborhood to categorize rocks present in the environment	I. S. 137	Colin Bradshaw		A. Hector J. Lippman

Highlights, Project City Science Activities
District 10

Field Trips
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Accompanied students on neighborhood tour to examine erosive agents effect on rock and soil	I. S. 137	Colin Bradshaw		A. Hector J. Lippman
Accompanied class to pet store to study ecological conditions of tropical fish	I. S. 137	Colin Bradshaw	Lorraine Ling	W. Naylor

Special Projects

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Assisted students with science fair projects	J. H. S. 141	Marcia Rudy	Sanford Wolf Susan Frank-McConnell	Roberta Fox Norman Larry Joe Sasiela
Organized weekly lunchtime science fiction club to view filmstrips & films	J. H. S. 141	Marcia Rudy		
Organized scenic displays-aquarium and plants in library	J. H. S. 141	Marcia Rudy		Susan Leffler

Highlights, Project City Science Activities
District 10

Special Projects
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Organized solar eclipse viewing with photographic film	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	Jay Norwood
Set up photo display of rocket club and launch in 6th grade classroom	J. H. S. 141	Marcia Rudy		Roberta Block Herb Herman
Article in Riverdale Press about rocket club and Project City Science activities in J. H. S. 141	J. H. S. 141	Marcia Rudy		Judith Korens
Attended science teachers meetings on curriculum adaptations	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	All science teachers Norman Kaufman
Interview with librarian from Spykn Dysil branch library	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	—

Highlights, Project City Science Activities
District 10

Special Projects
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Attended teacher workshop at NY Botanical Garden for field trip	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	
Visited Wavehill Environmental Center library to secure curricula materials for unit on environmental science	J. H. S. 141	Marcia Rudy	Susan Frank-McConnell	Talbert Spence
Conducted lunch-time sessions on computers and technology for interested students	J. H. S. 141	Marcia Rudy	Sanford Wolf	
Developed a list of science places to visit around NYC-special exhibits and tours	J. H. S. 141	Marcia Rudy		

Highlights, Project City Science Activities
District 10

Special Projects
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Assisted students with charting plant growth of bulbs planted in school garden	J. H. S. 141	Marcia Rudy		Sheila Devlin Marion Miller
Planned and implemented 2nd Annual I. S. 115 6th grade Science Fair	I. S. 115	Robert Callan		Kathy Sullivan Marcia Diamond Barbara Harris Simon Libfeld
Implementation of NYSED Mini-grant problem solving Reading-Science/ An experimental approach	I. S. 115	Robert Callan		Vicki Rusk Kathy Sullivan Marcia Diamond Barbara Harris Henry Eubanks Simon Libfeld
Implementation of "Living Science" program through District 10	I. S. 115	Robert Callan		Barbara Harris Vicki Rusk
Development and Implementation of research program in 6th, 7th and 8th grades	I. S. 115	Robert Callan Terry Jordan		Barbara Harris Kathy Sullivan

Highlights, Project City Science Activities
District 10

Special Projects
(continued)

Description	Location	On-Site Coordinator	Preservice Intern (s)	Cooperating Teacher (s)
				Henry Eubanks Vicki Rusk Simon Libfeld Marcia Diamond Marie DeCesare Denise O'Daly Andra Meyerson Craig Leonard
Developed science resource file on energy and electricity	I. S. 137	Colin Bradshaw	Lorraine Ling	
School held its second annual science fair with over 80 students participating	I. S. 137	Colin Bradshaw	Lorraine Ling Ellen Goldstein	Dimitri Cruz
Mini science talent class experimented on the effects of temperature and light on germination	I. S. 137	Colin Bradshaw		J. Lippman
Students experimented on the effect of various wave lengths of light on the production of CO_2 by plants	I. S. 137	Colin Bradshaw	Ellen Goldstein	Joel Rosenbluth

Highlights, Project City Science Activities
District 10

Special Projects (continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Students examined the effects of ecological imbalance on aquatic tank	I. S. 137	Colin Bradshaw	Lorraine Ling	W. Naylor
Newsletter was sent inviting parents to science fair. Ten parents attended as a result.	I. S. 137	Colin Bradshaw		
Enlisted librarian's support in establishing a science resource area with a special section devoted to ideas on how to make science projects	I. S. 137	Colin Bradshaw		
Assisted filming of teachers in preparing chemicals for use in setting up photo darkroom	I. S. 137	Colin Bradshaw		

Highlights, Project City Science Activities
District 10

Special Projects
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Attended Parent-Teacher conference	I. S. 137	Colin Bradshaw	Lorraine Ling Ellen Goldstein	J. Lippman R. Clunie J. Kartsch
Assisted staff with after-school recreation program	I. S. 137	Colin Bradshaw	Lorraine Ling	
Organized student lab team	I. S. 137	Colin Bradshaw	Lorraine Ling	
Developed activities for 7th grade unit on solids, liquids and gases using ideas from <u>Concepts and Challenges</u> and ESS	I. S. 137	Colin Bradshaw	Ellen Goldstein	J. Kartsch
Developed unit on effects of environmental changes on plant growth. Ideas were grafted from COPES and <u>Concepts and Challenges</u>	I. S. 137	Colin Bradshaw	Lorraine Ling Ellen Goldstein	R. Clunie J. Rosenbluth

Highlights, Project City Science Activities
District 10

Special Projects
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Interns jointly taught a small group of 12 students who were 3 years retarded in reading, math and science using the IIS Curriculum. After a term's work those students have developed cognitive skills	I. S. 137	Colin Bradshaw	Ellen Goldstein Lorraine Ling	Dimitri Cruz

Workshops

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Conducted three workshops with teachers, supervisors and interns to determine the organizational procedures for the science fair	I. S. 137	Colin Bradshaw		Arline Weisberg (Sci Crd) Dimitri Cruz Jack Kartsch Rose Clunie

Highlights, Project City Science Activities
District 10

Workshops
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Conducted special workshop with interns and students who would assist in operating and maintaining activities associated with science fair	I. S. 137	Colin Bradshaw	Lorraine Ling Ellen Goldstein	Jack Kartsch Rose Clunie Jessica Lippman
Conducted workshop with teachers to determine what areas of the N. Y. C. curriculum could best be enriched by using "hands-on" and experiential activities	I. S. 137	Colin Bradshaw		6 teachers from dept.

TABLE

Highlights, Project City Science Activities
District 15

Curriculum Adaptation

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Developed 8th grade lab physics curriculum including school wide contests and surveys (based on Science 5/13, ISIS, and others)	J. H. S. 142	Arthur Kaufman		
Adapted unit on sound and music for 9th grade from N. Y. C. Board of Education curriculum and ISIS	J. H. S. 142	Arthur Kaufman		
Developed and implemented introductory laboratory science lessons for visiting elementary school pupils	J. H. S. 142	Arthur Kaufman		
Developed unit on rocks and minerals	J. H. S. 142	Arthur Kaufman		David Fishbein Arthur Kaufman
Developed unit of biology lessons including use of local lake water, human body cells, microscopy techniques	J. H. S. 142	Arthur Kaufman	Ray McGowan Stacey Mizl	Peter Manfredi Arthur Kaufman

Highlights, Project City Science Activities
District 15

Curriculum Adaptation
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Designed and implemented lessons on food chains	J. H. S. 142	Arthur Kaufman	Stacey Mizl	Arthur Kaufman
Developed unit on light	J. H. S. 142	Arthur Kaufman	Stacey Mizl	Peter Manfredi Arthur Kaufman
Introduced Mystery Powders in chemistry unit	J. H. S. 142	Arthur Kaufman	Stacey Mizl	Arthur Kaufman
Developed unit on heat	J. H. S. 142	Arthur Kaufman	Stacey Mizl	Arthur Kaufman
Developed lessons on measurement of time (adapted from Science 5/13)	J. H. S. 142	Arthur Kaufman	Stacey Mizl	Peter Manfredi
Adapted unit on magnetism from ESS 7th grade	J. H. S. 142	Arthur Kaufman	Stacey Mizl	Arthur Kaufman
Adapted a unit on matter and forces from N. Y. C. Board of Education curriculum	J. H. S. 142	Arthur Kaufman	Ray McGowan	David Fishbein

Highlights, Project City Science Activities
District 15

Curriculum Adaptation
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Developed a unit on seeds	J. H. S. 142	Arthur Kaufman	Ray McGowan	Peter Manfredi
Developed lessons on forces	J. H. S. 142	Arthur Kaufman	Ray McGowan	David Fishbein

Special Projects

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Accompanied student entrants to SEER energy exhibits, aided students with their projects	J. H. S. 142	Arthur Kaufman	Stacey Mizl	Peter Manfredi
Arranged for tour of school's heating plant	J. H. S. 142	Arthur Kaufman	Ray McGowan	David Fishbein Leonard Polikoff (Custodial Engineer)
Organized school science fair	J. H. S. 142	Arthur Kaufman	Ray McGowan Stacey Mizl	David Fisbein Lewis Gerber Arthur Kaufman Peter Manfredi Bernard Zapkin
Conducted science projects workshop with students	J. H. S. 142	Arthur Kaufman	Stacey Mizl	

Highlights, Project City Science Activities
District 15

Special Projects

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Designed school weather station, constructed of existing materials	J. H. S. 142	Arthur Kaufman	Ray McGowan	David Fishbein
Organized school weather club, duties included daily weather reports over P. A. system	J. H. S. 142	Arthur Kaufman	Ray McGowan	David Fishbein Bea Neu Melov (Principal)
Arranged series of trips to Gateway-Breezy Point Unit, tied in with ecology unit	J. H. S. 142	Arthur Kaufman		David Fishbein

TABLE

Highlights, Project City Science Activities
District 17

Curriculum Adaptation

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Developed and adapted a series of lessons on how to prepare and take care of fish tanks	I. S. 320	Taddesse Aregahegn	Christopher Bender	Ellen Packman
Adapted a series of lessons on the microscope and used the microscope in studying sea life	I. S. 320	Taddesse Aregahegn	Christopher Bender	Ellen Packman
Developed a unit on reptiles and encouraged the students to make a first hand observation of snakes, frogs, etc.	I. S. 320	Taddesse Aregahegn	Christopher Bender	Ellen Packman
Developed a unit on how science fiction is related to real science	I. S. 320	Taddesse Aregahegn	Christopher Bender	Ellen Packman
Developed a series of lessons emphasizing the relative sizes of objects	I. S. 320	Taddesse Aregahegn	Christopher Bender	Ellen Packman

Highlights, Project City Science Activities
District 17

Curriculum Adaptation (continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Adapted and taught several lessons from the N. Y. C. science curriculum which were used in a "team teaching" situation	I. S. 391	Alan Backer	Ingrid Wisniewski	Lelie Heffner
Developed and taught a "hands-on" curriculum for use in special guidance classes	I. S. 391	Alan Backer		Ellen Fair

Field Trips

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Accompanied science on field trip to the Botanic Gardens	I. S. 391	Alan Backer		Leslie Heffner

Special Projects

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Videotaped preservice interns while they were conducting their science class	I. S. 391	Alan Backer	John Conti Ingrid Wisniewski	Bob Harwood Leslie Heffner
Organized and produced student-written science newsletter	I. S. 391	Alan Backer	Ingrid Wisniewski	Leslie Heffner

Highlights, Project City Science Activities
District 17

Special Projects
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Administered "self-concept of achievement" tests to classes involved in a doctoral thesis being conducted by one of the science teachers	I. S. 391	Alan Backer	John Conti	Christine Abate Gail Derrico
Organized school-wide science fair	I. S. 391	Alan Backer		Mel Kramer (Ass't Prin)
Photographed science fair projects and participants and organized photo display	I. S. 391	Alan Backer		Mel Kramer (Ass't Prin)
Assisted individuals prepare their final science fair exhibits and coordinated science fair	I. S. 320	Taddesse Aregahegn	Christopher Bender	Ellen Packman
Developed a unit on animal behavior with special emphasis on fish and gerbils	I. S. 320	Taddesse Aregahegn	Christopher Bender	Ellen Packman

Highlights, Project City Science Activities
District 17

Workshops
(continued)

Description	Location	On-Site Coordinator	Preservice Intern(s)	Cooperating Teacher(s)
Conducted several inclass student workshops on "How to Organize a Good Science Project"	I. S. 391	Alan Backer		Lou Hiers Leslie Heftner Bob Harwood

RESEARCH PROGRAM

Spring, 1979 proved to be a rather hectic time for the research team. This situation was compounded by the departure of two staff members from the research team. Dr. Philip Merrifield was on sabbatical leave this semester, and on April first Dr. Theresa Jordan joined the staff of the Institute for Developmental Studies at New York University as Evaluation Specialist. As a result, the research team was left with two members, Dr. Mae Lee and Ms. Tina Jacobowitz, to carry out the remainder of the Project research tasks. These were the planning and implementation of a research study on student achievement in I. S. 391, posttesting of our 1978-79 preservice interns, and preparation of draft material for the Final Report to the National Science Foundation. In addition, as mentioned in the Fall, 1978 Progress Report, the research team utilized the early months of the Spring semester to prepare research papers for presentation at EERA, NARST, and AETS.

Presentation of Research Papers

During the week of February 21-24, the research team, Dr. Mae Lee, Dr. Theresa Jordan, and Ms. Tina Jacobowitz presented two papers at the meeting of the Eastern Educational

Research Association (EERA) in Kiawah Island, South Carolina. Dr. Jordan's paper focused on the relations among academic achievement and the personality variables, global self-concept, academic self-concept, and need for academic competence. This paper was based on her doctoral thesis, which she completed in Fall, 1978. Dr. Lee and Ms. Jacobowitz presented a joint paper, which examined the relations among achievement in English, math, social studies, and science, career expectations, and the variables, global and academic self-concepts, and need for academic competence. Major findings of these studies were reported in the Fall, 1978 Progress Report. These presentations from PCS were scheduled for the session which included papers by Dr. Philip Merrifield and Dr. Wilbur Brookover, a foremost authority of self-concept and achievement.

Drs. Mae Lee, Theresa Jordan, and Fletcher Watson also attended the NARST and AETS meetings in Atlanta, Georgia during March, 1979. At NARST the research team presented a paper set, which included a paper exploring the science career expectations and perceptions of scientists among inner-city science students in I. S. 391. Another paper focused on the cognitive and affective correlates of science and math achievement. A third paper examined the relationship between science care : expectations and global

self-concept, academic self-concept, and need for academic competence. The results of these studies were also presented in previous Progress Reports.

In addition to the NARST meeting, Drs. Lee and Jordan presented at AETS a paper which described the development and evaluation of the 1976-77 PCS Preservice Program. In general all the papers were well received, especially those presented at NARST, for which the research team has had numerous requests for copies of these papers.

Study on Students

A second task completed by the research team was the design and data gathering for a study investigating the relationship between students' self-concepts in each of their academic subjects (i.e. English, math, social studies, and science) and their achievement in these respective subject areas. This study is an extension of that conducted in the spring of 1978 when the relationship between academic and global self-concepts and achievement in specific subjects were examined. Now, the relations among self-concepts and academic-specific locus of control in regard to achievement are being examined. Thus far, all data have been collected and coded. The analyses of these data is planned for completion during the summer months.

Also mentioned in Progress Report No. 15 was the preparation of a preliminary proposal to be submitted to NSF by Dr. Lee and Dr. Jordan. This proposal was completed at the end of January and forwarded to NSF for review. A formal response from NSF was not received until March. Although the response to the proposal was somewhat positive, the staff decided that with the constraints on PCS staffing and time, it would not be feasible to prepare an extended formal version of the proposal.

Posttesting of Preservice Interns

As in the previous spring semesters, posttesting of the interns took place during the month of May. Only the two attitude Q-sorts, the Problem-Identification Q-sort, and the Decisions in Teaching instruments were administered as posttests to assess the interns' changing perceptions. In addition the onsite coordinators participated in the Decisions in Teaching assessment, which describes their teaching orientations. All the data on the preservice and onsite coordinators have been gathered, and will be analyzed during June.

During May, the preservice interns were encouraged to take the regents examinations to complete their science content requirements. Thus far, ten out of the fourteen

remaining preservice interns have met their regents requirements. That is, the ten interns have achieved a score of 90 on one regents examination and at least a 65 or the other three area examinations. The others of the 1978-79 interns should have these requirements fulfilled by the end of the summer term. Although the regents examinations are not ultimate criteria of a teacher's knowledge, the following table of results show that our interns, who were not "preped" for the tests, do have considerable knowledge in the range of subjects considered in middle school science.

Regents Exam Scores

Preservice 1978-79

Intern	Biology	Earth Science	Chemistry	Physics
#1	91	81	75	89
#2	78	82	98	96
#3	92	90		
#4	78	87	96	91
#5		93	65	68
#6	100	96	87	99
#7	67	81	90	73
#8	73	86	74	91
#9	97	87	80	
#10	100	96	97	93
#11	87	90	71	95
#12	92	99	71	73
#13	99	98	94	98
#17		83	87	

PROJECT CITY SCIENCE
CITISCIENCE NOTES

NEW YORK WINTER 1978

WEATHER WATCHING

Mackerel Skies -- Not Too Long Dry
Red Sky At Night -- Sailor's Delight
Ring Around The Moon -- Rain or Snow Soon
Red Sky In Morning -- Sailors Take Warning

Weather has been man's constant friend and foe since before the days of Thor and his thunderbolts. While some people claim to "feel it in their bones," most of us count on a more scientific approach to forecasting weather.

Winter months are ideal for weather watching. New York endures temperature highs and lows...wind, rain, sleet and snow...clear skies, grey skies, frost and ice.

Whatever else can be said about *Old Man Winter*, he certainly isn't boring!

Setting up a weather station brings a bit of the outdoors indoors. It's an easy, fun and inexpensive way to involve students in collecting and interpreting scientific data.

This issue of <u>citiscience notes</u> provides some background information and classroom activities. There are more ideas to be had -- all free or inexpensive *(we've listed some sources in "Free and Inexpensive").*

STARTING WITH THE SUN

Watch the wind and the clouds and you'll know a lot about the weather. But remember -- *weather* is a short-term affair -- *climate* stays the same over thousands of years. It all starts when the sun's heat is absorbed unevenly by the water and the land.

<u>*TRY THIS*</u> *See how temperature differences occur*

Materials: 2 pie tins, water, soil, thermometer, lamp

Fill one pie tin with soil and one with water. Take the temperature of each and record. Place a lamp over the tins so that each gets an equal amount of light. After 10 minutes, record the temperature again. Turn off the lamp. During the next 10 minutes record the temperature of the soil and the water at one-minute intervals.

What are your observations?

Can you explain how gusts of wind at the shore move mostly in one direction in the morning and in another direction in the evening?

Now let's try a few simple experiments that will reveal enough about the properties of air so that you can also understand more about winds and clouds.

A SEA OF AIR

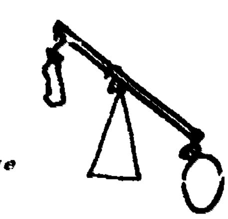
Two years after Galileo died in 1642, his pupil Torricelli used the simple barometer that Galileo devised to experiment with air pressure. From these experiments he wrote, *"We live at the bottom of a sea of elemental air, which by experiment undoubtedly has weight, and so much weight..."*

<u>*Air Has Weight*</u>

<u>*TRY THIS*</u> *Weigh the air around you*

Materials: 1 balance rod, 3 balancing clips, 1 wire support, 2 balloons of equal size

Fasten the 2 balloons to the clips as shown. Balance the rod by moving the third clip (you may have to move it along the wire support).



Remove one of the balloons, blow it up and knot the neck. Place the balloon on a table for 5-10 minutes. Then reattach it to the balance arm. Hold the arm level, then gently release it and observe what happens.

The breath you blew into the balloon was warmer than the air in the room. That's why you had to wait a few minutes. This wait gave the air in the balloon time to cool off. (Instead of using balloons, you can also use 2 deflated soccer or volley balls. Balance the 2 balls on a scale, then inflate one with a pump.) What happens?

<u>*Air Exerts Pressure*</u>

<u>*TRY THIS*</u> *Bottle an egg with a little bit of pressure*

Materials: 1 peeled, hard-boiled egg, 1 glass quart milk bottle, matches

Insert a piece of burning paper into the jar. Quickly place the egg on the mouth of the jar.

Can you explain what happens in terms of air pressure?

<u>*TRY THIS*</u> *Build a simple barometer* *(see p.4)*

<u>*Cooling Air Releases Moisture At Its Dew Point*</u>

<u>*TRY THIS*</u> *Collect moisture from the air at the dew point*

Materials: 1 can, food coloring, ice, thermometer

Fill the can half full of water. Add some food coloring to the water. Stir in a small piece of ice. Continue to stir with a thermometer until the ice melts.

Repeat using 1 piece of ice at a time. Record the

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temperature at which the ice melts. When you first spot moisture on the outside of the can, record the temperature of the water. This temperature is the __*dew point*__ *of the surrounding air.*

(Note to teachers: Food coloring is added so that students don't confuse condensation with water inside the can.)

This condensation can be easily observed on the inside of windows during cold weather. In warm weather, dew forms on the outside of chilled soda cans and glasses of iced tea.

When moisture appears on the ground, it is called dew. When moisture forms around dust particles in the air, fog or clouds appear.

UNDERSTANDING THE WINDS

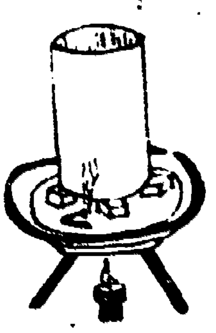
While the sun's heating of land and sea explains the difference in wind direction in the morning and in the evening, the cause of prevailing *westerly* winds that blow across the United States from the southwest to the northeast needs more explanation.

Air Currents

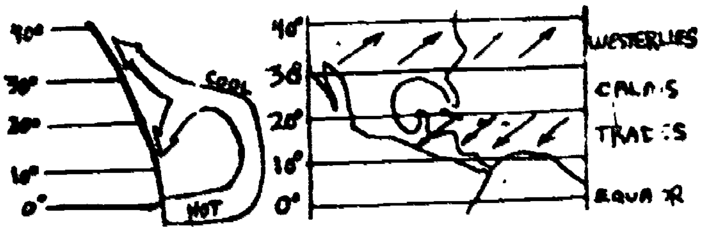
__*TRY THIS*__ *Which way does the wind blow?*

Materials: 1 sheet of typing paper, 1 metal plate, 4 supporting blocks, 1 candle or burner, string cut into lengths of 10 cm, plastic tape

Bend the paper into a tall cylinder and tape it. Place the cylinder on supports in the center of the plate. Place the plate on a metal stand. Fold the string and place it in a flame. Let the string smoke, but don't let it catch fire. When the string begins to smoke, place it on the edge of the metal plate. Observe the smoke. Now place the candle under the center of the plate. Observe.



Think of the center of the plate as the equator. Hot air rises high above the earth and gradually cools. Other air flows in from the sides and replaces this rising air. The new air also warms and begins to rise. Try to picture the cooled air returning to earth.



When the air above the equator returns to earth, it divides into currents. These currents travel north and south, either along with or opposite to the direction the earth spins. At the point where this air returns to earth, it forms the calms.

Sailors of yore dreaded the calms *(also called doldrums or horse latitudes)*. If they were caught in the calms, they could be stranded for weeks, run out of food and be forced to eat their horses to stay alive.

To the south, trade winds form -- to the north, the westerlies form. Early sailors from Europe to America traveled to the New World on the trade winds. They returned home to Europe from America on the westerlies.

Remember: Because of the rotation of the earth from west to east *(left to right on the diagram above)*--

1. Prevailing winds across the United States are from the southwest
2. Local winds move from a high (H) pressure area to a low (L).

UNDERSTANDING THE CLOUDS

Curdled Sky -- Not 24 Hours Dry
In The Morning Mountains -- By The Evening Fountains

There are fair weather clouds and foul weather clouds. Clouds that bring rain and clouds than bring blue skies. Once you learn to recognize basic cloud types, you will be able to read the story clouds tell about weather.

You already know from your experiments with dew point that moisture forms when air cools below the dew point. This moisture can condense on dust particles in the air. This usually happens when air moves up and over mountains and cools. Clouds also form when a cold air mass pushes warmer air high enough for moisture in the warmer air to condense as it cools.

__*TRY THIS*__ *Make clouds from pressure changes*

Materials: 1 large, wide-mouth jar, 1 large balloon cut into a curved rubber sheet, matches, rubber bands

Pour the water into the jar. Cover with the rubber sheet and fasten the sheet to the jar with 3 rubber bands. Strike a wooden match. Ask a classmate to uncover the jar. As this is done, flick out the match and lower it into the jar to trap some of the smoke. Quickly replace the rubber cap and fasten tightly. Wait 1 minute

Press down on the cover and hold for 5 seconds. Then pull up on the cover fast and hard. Observe.

Press down and pull up on the cover several times. *Does the same thing happen each time you pull up on the cover?*

In a dark room, shine a flashlight on the jar. The light will reflect droplets of water. What causes the droplets to condense? To evaporate?

__*TRY THIS*__ *Make clouds from temperature changes*

Materials: 2 jars, 1 plastic bag, ice cubes, matches

Hold the plastic bag filled with ice cubes over a jar of cold water. Next hold the bag over a jar of hot water. Observe. Place a smoking match into the jar of hot water. Hold the bag of ice over the jar and observe.

Families of Clouds

There are many possible combinations of clouds. Of all the many kinds of clouds you see in the sky, there are 4 basic families:

Cumulus Clouds *look like large puffs of cotton. They usually indicate fair weather ahead.*

Cumulonimbus Clouds *are thunderstorm clouds. They bring rain, hail and strong winds. Cumulonimbus forms most often in warm weather.*

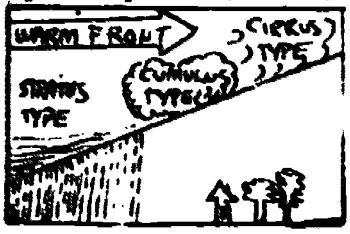
Stratus Clouds *are found at lower altitudes and form a dull grey curtain across the sky. This cloud accompanies all-day drizzle.*

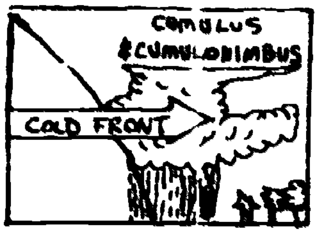
Cirrus Clouds *look like curls of hair and are found at high altitudes. They are made of very fine ice crystals and are delicate in appearance. Cirrus clouds usually mean good weather.*

UNDERSTANDIN WEATHER FRONTS

Before you can read a weather map or fol ow the weather report on the six-o'clock news, ou must understand weather fronts -- or the edge of moving masses of warm or cold air.

A warm front occurs when the edge of a mass of warm air overtakes a mass of cold air. At the front of this air mass, the warmer, lighter air is forced upward by the heavier cooler air.





A cold front occurs when the edge of a cold air mass cl. hes with a warm air mass coming from the opposite direction. When this happens, the cold air forces the warm air up even more rapidly. As the warm air rises, it cools. When it cools below the dew point, moisture collects on dust particles. Clouds form. If enough moisture collects on the dust particles, rain, snow, sleet or hail may fall *depending on the temperature of the air.*

This is called precipitation.

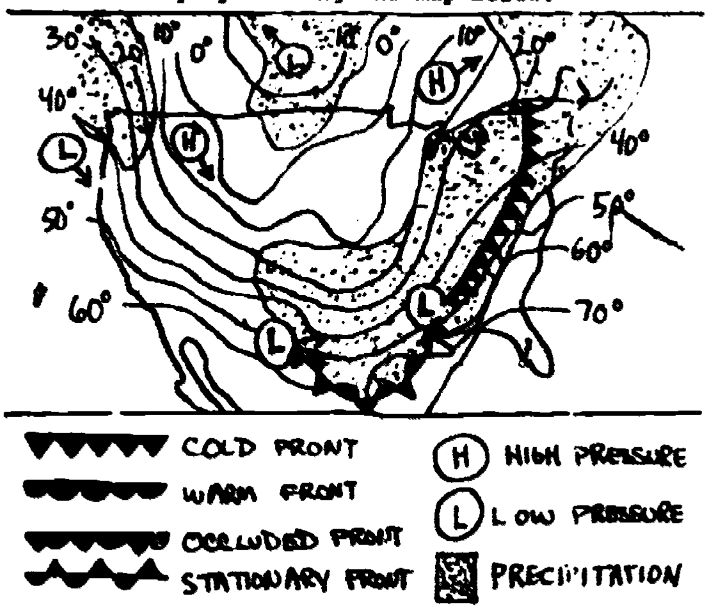
READING A WEATHER MAP

By plotting weather information on a map, wehthermen *(meteorologists)* try to predict tomorrow's weather.

Reading a weather map is easy once you learn a few basic symbols.

Weather maps show high (H) and low (L) pressure areas, cold and warm weather fronts, precipitation and clear weather.

This map is similar to weather maps printed by the <u>New York Times</u>. Can you guess the forecast for <u>New York City</u> by reading the map below?



Where are the cold fronts? Where are the warm fronts? Can you spot any stationary fronts? What kind of weather do you find near high pressure areas? What do you find near low pressure areas? Which way do these fronts move? What has happened to weather fronts over South Dakota, Minnesota, Utah and Montana?

WATCHING THE WEATHER

What do you look for when you look at the weather?

Most weather predictions, or forecasts, cover a 48-hour period. They are called short-range forecasts. *(Keep a file of reports for your records).*

You can learn to make your own weather predictions. To do this, you will need a daily log for recording the weather in your town. You will also need a few pieces of equipment which you can build in class or at home *(we show you how on pp 3-4).*

Compare your observations to the weather maps and weather reports in your area.

A few guidelines for translating your observations into weather predictions...

WEATHER ELEMENTS	SIGN	PROBABLE CHANGES
AIR PRESSURE	RAPID DROP	FRONT APPROACHING-RAIN OR SNOW.
CLOUDS	CUMULONIMBUS	THUNDERSTORMS
	CUMULUS	FAIR WEATHER
	ALTOSTRATUS	WARM FRONT-NO RAIN UNLESS CLOUD CHANGES
MISCELLANEOUS	WIND DIRECTION CHANGES QUICKLY	ADVANCING OR RECEDING FRONT
	COOL CLEAR DAY WITH LITTLE WIND	HIGH PRESSURE OVER AREA-WEATHER REMAINS FAIR

Measure weather variables at the same time each day for several days. Keep a record of weekend weather also.

Your weather log will look something like this:

	Dec. 31,1978	*Jan. 1,1979*
TEMPERATURE RANGE	*26-22°C*	
CLOUDINESS	*75%*	
CLOUD TYPE	*Cumulus*	
WIND SPEED (MPH)	*5-8 mph*	
WIND DIRECTION	*N-NW*	
BAROMETRIC PRESSURE	*29.7 inches*	
PRECIPITATION	*.5*	

BUILDING A WEATHER STATION

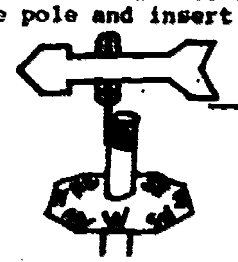
1. <u>Build a Wind Vane</u>

Materials: thread or string, 1 coat hanger bent into a circle at one end, 1 nylon stocking

Tie the stocking to the coathanger to form a wind sock as you would see at an airfield, *OR...*

Materials: 2 pieces of cardboard or thin board 50 cm by 10 cm, 1 test tube, 1 pole, 1 nail, string, plastic tape and glue

Cut the board into the shape of an arrow. Glue both ends together and balance the arrow on your finger. Where the arrow balances, glue the test tube between the 2 pieces. Tie the nail to the pole and insert into the test tube as shown.

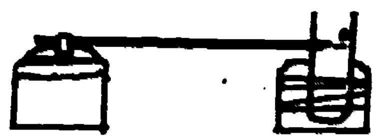


Mark the pole in 8 places so the arrow will point to the direction the wind comes from: N, NE, E, SE, S, SW, W, NW

Build an Air Pressure Indicator (Barometer)

Materials: 1 plastic straw, 1 tongue depressor (or index card), 4 rubber bands, 1 balloon, 2 small baby food jars, plastic tape, scissors

Cover one empty jar with a balloon--pull taut and seal tightly with rubber band. Cut one end of the straw to make a point. Tape the other end to the middle of the balloon. Attach the tongue depressor or card to the second jar with 2 rubber bands. Place the two jars as shown and mark "0" where the straw hits.



Place the balloon-covered jar in hot, then cold water and see how the pointer moves. This tells you that to use it to measure air pressure, it should be kept in a place where the temperature is constant.

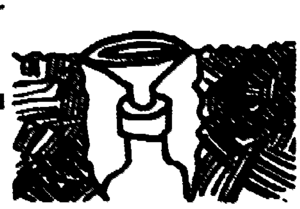
Calibrate it with a standard barometer from school or by listening to the daily weather reports. The zero point can be marked as 30" or 760 mm, which stands for how high a column of mercury could be supported by the atmospheric pressure at sea level.

If you had a slender hollow tube, closed at one end and filled with mercury, by inverting this tube into a bowl of mercury, the mercury would drop only 6". The atmosphere would support about a 30" column of mercury or a column of water over 30' high.

Build a Rain Gauge

Materials: 1 funnel, a bottle, a measuring cylinder

Chose a funnel with a very sharp vertical edge or a horizontal lip. This will prevent raindrops from bouncing out. Arrange the rain gauge as shown and bury it a few centimeters above ground level in an open, undisturbed area.



Build a Wind Speed Indicator

Materials: 2 nails, a board about 12 cm on each edge, flat metal strips 2 cm x 10 cm (cut from aluminum tin can), automobile and driver

Assemble according to the diagram and calibrate it by taking the speed indicator for a car ride on a windless day. Hold the indicator out the window and mark the speeds from 5-50 mph (multiply by .6 to convert to km/h).

FOR THE BOOKSHELF

Sourcebook for Earth Sciences and Astronomy. *Russell O. Utgard, George T. Ladd, Hans O. Andersen. The Macmillan Company, New York. Good source for inexpensive and free materials. Complete with survey of textbooks and supplementary reading materials.*

Stormy Weather (ISIS). *Ginn and Company, Lexington Massachusetts. Covers a broad range of weather topics. Easy to comprehend and well illustrated with black and white drawings and photos.*

Winds and Weather (ISCS, Level III). *Silver Burdett General Learning Corporation, Morristown, New Jersey. Challenging, comprehensive text with emphasis on activities.*

FREE & INEXPENSIVE MATERIALS

The booklets, pictures and maps listed below are free or inexpensive to students and teachers. Restrictions on materials are noted below. When requesting materials, use school stationery and state the title and number of copies for each item you are requesting.

The Aneroid Barometer 15¢ USGPO

Cloud Chart (1 copy per teacher) free SA

Instructions for Home Weather Casting Construction of an aneroid barometer & its use (1 copy per teacher) free TIC.

Weather Observing. $1.00 USGPO

Smog and Weather. free NCA

Snowflakes. free ASRC

Weather Bureau Activities. free ESSA

Weather Forecasting. 25¢ USGPO

What Is This Thing Called Humidity. free TIC

Winter Storms. 15¢ USGPO

Air Pollution Experiments for Jr. & Sr. High School Classes. $1.00 APCA

Weather, Astronomy and Meteorology Publication Lists. free USGPO

Climates of the World. 10¢ USGPO

Climate of the United States. 20¢ USGPO

Clouds. (pictures) 25¢ ESSA

Lightning. 15¢ USGPO

Weatherman of the Sea. free USGPO

Selected Climatic Maps of the United States 25¢ USGPO

Hurricane Information and Atlantic Tracking Chart. 15¢ ESSA

WHERE TO WRITE...

APCA
Air Pollution Control Association
4400 Fifth Avenue
Pittsburgh PA 15123

ASRC
Atmosphere Sciences Resources Center
State University at Albany
Albany, NY 12203

ESSA
Earth Scinece Curriculum Project
P.O. Box 1559
Boulder, CO 80301 *(free materials limited to 5 copies per teacher)*

NCA
National Coal Association
Education Division
Coal Building
1130 17 Street N.W.
Washington, DC 20036

USGPO
U.S. Government Printing Office
Superintendent of Documents
Washington, DC 20402

TIC
Taylor Instrument Companies
Advertising Department
95 Ames Street
Rochester, NY 14601

SA
Science Associates
P.O. Box 216
Princeton, NJ 08540

PROJECT CITY SCIENCE

CITISCIENCE NOTES

NEW YORK SPRING 1979

CITISCIENCE TAKES UP SPACE

What do you see when you look up into the heavens? Can you spot different objects moving across the sky? Why does the sun seem lower in the winter than in the summer? Do you see the moon changing shapes during the month from silvery sliver to full-faced Man in the Moon? How do the stars move? What holds the moon high up over the Earth?

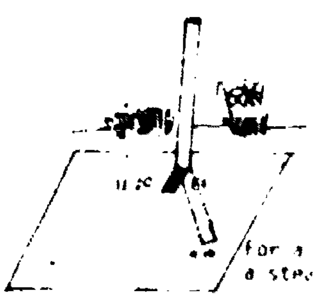
Ancient people looked up into the heavens and asked these same questions. Like you, they saw the sun rise and set regularly and called this day. They observed that the moon was full about every 28 days (one month). They watched the position of the stars change slowly each night until they returned to the same place in the sky about every 365 1/4 days (one year).

The ancients noted that the planets and the moon follow the same path across the sky as the sun does during the day. This path is called the ecliptic because eclipses occur along it. The ecliptic is a wide belt whose boundaries are marked by the highest position of the sun on June 21 and the lowest position on December 21. June 21 is the longest day in the year -- December 21 is the shortest. They are called solstice from the Latin word meaning "sun stands." Mid-way between these two days there are two other days when daylight and nighttime hours are equal. These [illegible], March 21 and September 2, are called equinoxes.

[illegible] the sky for a day, [illegible] setting up a shadow [illegible]

[illegible] instructions below.

BUILDING A SHADOW STICK



Find an open space in the school yard that you can use daily. A southern exposure not obstructed by tall trees or buildings is ideal.

Students can make individual shadow sticks by punching a flat headed nail or golf tee up through a piece of cardboard.

For a more permanent model, nail a dowel to a steady flat surface.

Cut sheets of paper to fit over the dowel or nail. You will trace the length and direction of the shadow on these sheets of paper.

* Use a different color marker or crayon each day. Record the time of the shadow on the paper.
* Be sure to set up the shadow stick vertically for each reading. Orient the paper in the same direction with each use.
* The shadows cast by building edges, lamp posts, or other tall, permanent objects can also be used.

BUILDING A SUN DIAL

Select a site as suggested in the Shadow Stick activity. You can use the permanent Shadow Stick described above or the cardboard model for simple experiments.

Cut sheets of paper to fit over the dowel or nail and mark the length and direction of the shadow *once every hour on the hour.* After tracing the shadow, mark the time of the reading.

Once you have marked off as many daylight hours as possible, you will be able to tell time by checking the position of the shadow on the face of the sun dial.

SETTING UP A SUN REFLECTOR

Place a mirror on the classroom window ledge. Attach it permanently on an angle so that the sun's reflection hits the wall and not the ceiling.

Once a week, make a small mark on the wall where the sun's reflection hits. Repeat this activity for the entire term, marking the reflection *at the same time daily.*

After a few weeks you will notice a pattern forming on the wall.

What can you discover by following these activities? This depends on the time and frequency of the [illegible]...

...IF YOU RECORD SHADOWS	...YOU WILL DISCOVER...
All day long	*sun's path through the sky for that day*
All day long, once weekly	*changes in sun's path from week to week*
once a day, same time daily	*changes in the length and direction of shadows (sun dial, shadow stick)*
[illegible] daily	*changes in length and direction of shadows (sun dial, shadow stick)*

WHAT THE ANCIENTS SAW

Since twelve risings and settings of the moon occured before the sun completed its yearly travel, the ancients divided the ecliptic into twelve sections. The Greeks made up pictures and stories to go along with the group of stars in each section. These star pictures, or constellations, make up the twelve signs of the zodiac. Astrologers soon began "reading" the stars to make predictions about life on Earth.

[illegible] build your own model [illegible] (See page 3 for instructions)

In ancient Egypt, farmers anxiously watched the sky for Sirius to appear. The dog star Sirius rises just as the mighty Nile River floods its banks. Egyptian farmers knew that once they spotted Sirius, there would soon be enough water to carry rich soil for new crops.

Published monthly during the school year by Project City Science, funded by the National Science Foundation and operating from New York University School of Education, Health, Nursing and Arts Professions

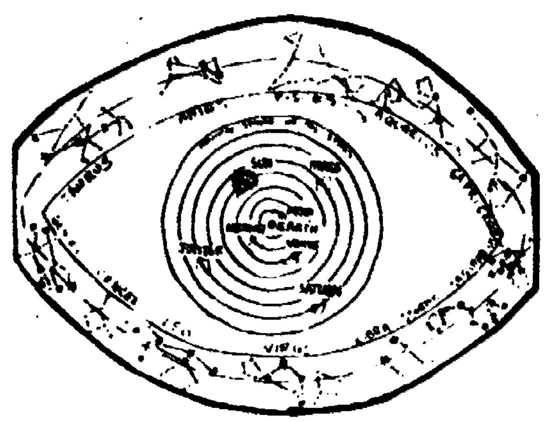
Across the Arabian desert in Babylon astrology made the difference between night and day. Babylonian priest-astrologers believed that the twelve zodiac signs held great power over the fate of their kingdom. Not only did the twelve yearly risings and settings of the moon determine the number of zodiac constellations, but they were also used by the Babylonians to assign twelve hours to the day and twelve hours to the night. The Babylonians divided up space as well as time. They divided the circle into 360°, probably using this number because it is close to the number of days in one year and is a composite number of many factors, e.g. 5, 10, 12, 24, 60, 120...

What are the zodiac signs? What is astrology? What is astronomy?

Many people confuse astrology with astronomy. Both deal with observations of the stars, but only astronomy is based on the study of scientific data.

Astrologers predict events on earth by giving heavenly bodies a personality and then observing their behavior in the sky.

Are you a moody Moon Child? A Rowdy Ram? Turn to the astrology section of a daily newspaper to find out. There you'll find a listing by dates of the twelve zodiac constellations. Choose the zodiac sign that includes your birthday. What do today's astrologers say about you?



(This diagram shows the ecliptic and the ancients' view of an earth-centered universe. Can you find your zodiac sign?)

Star gazing came naturally to early shepherds as they guarded their flocks at night. Scholars of the day kept detailed records of the position and movement of the sun, the moon, the stars and the planets. They believed that the stars were affixed to a giant celestial sphere that turned slowly in the heavens. They watched the regular movement of the sun and the moon and also noted other heavenly bodies wandering across this sphere of stars.

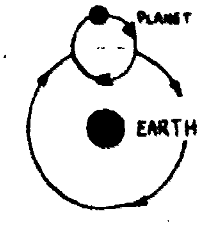
The Greeks called these heavenly bodies *planets* from the Greek word for wanderer. Five of these planets are named for the gods. You may be able to recognize these names in several languages -- *Martes* (Mars), *Mercredi* (Mercury), *Jueves* (Jupiter), *Viernes* (Venus), *Saturday* (Saturn).

While some civilizations believed that the Earth rode on the back of some huge turtle and others that the planets were really gods, the Greeks continued to search for a more logical explanation for the motions in the heavens.

The Greeks believed that the Earth was the center of the universe and remained stationary. The stars, they thought, were attached to a giant sphere. The sun, the moon and the five planets moved across this sphere of stars -- but the ancient astronomers saw something else they could not explain. As the planets moved across the ecliptic, they seemed to slow down, back up and then go forward again. How did this happen?

In 150 A.D., the Greek astronomer Ptolemy tried to solve this mystery by constructing a model of the universe. *(See earth-centered diagram above.)*

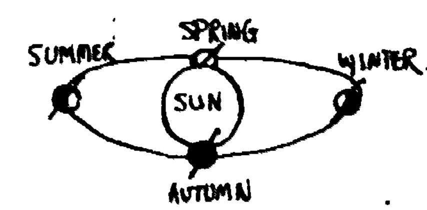
Ptolemy said that the stars were indeed attached to a giant hollow sphere that revolved around the Earth. The Earth was the center of the universe and did not move. Ptolemy then explained how the sun, the moon and the planets moved in perfect circles around the Earth. The planets seemed to slow down and back up because each planet travels in a small circle as it orbits the Earth in a larger circle.



For over 1,500 years, Ptolemy's model was accepted by the world. But his model did not satisfy astronomers who sought a simpler model for the motions in the heavens.

Nicolaus Copernicus, a Polish astronomer, thought he found a better way. In 1543, Copernicus replaced the Earth-centered universe *(geocentric)* with a sun-centered universe *(heliocentric)*. Copernicus said that all the planets, including Earth, orbit the sun in perfect circles. We see different stars at different times, he added, because the Earth rotates on a tilted axis as it orbits the sun. This tilt *(23°)* explains why the sun is highest in the summer sky and lowest in the winter. The tilt of the axis causes parts of the Earth's surface to receive different amounts of sunlight during the year. This tilt and the Earth's revolution around the sun gives us the four seasons. The stars are fixed in the sky and do not turn on a giant sphere as the early Greeks had thought.

(Copernicus' Model)



(The Four Seasons)

SIZING UP THE HEAVENS

Most students have no idea just how big the sun really is or how far the planets are from one another. To get a better grasp on this celestial situation, why not turn the sun into something more manageable -- a beach ball, perhaps? Scale down the entire solar system so that students can see these differences for themselves.

ACTIVITY I

Find the diameters of the sun and the planets in kilometers (km). Scale down the diameter of the sun to 100 centimeters (cm).

Reduce the diameters of the planets by the same proportion. These clues will help --

> *The sun's diameter is 100X that of Earth and Venus*
> *Mercury, Mars and Pluto span approximately 1/2 the diameter of Earth*
> *Uranus and Neptune are about 3X larger than Earth*

Take a compass and draw scale models of all the planets using a common midpoint. The end result should look like nine concentric circles.

Label each circle with the name of the planet it represents.

It would be impossible to draw on a single piece of paper a circle large enough to represent the sun. Instead, center a meter stick across the diameter of the planets. The length of the meter stick will represent the diameter of the sun.

ACTIVITY II

Turn your scale model of the planets into a tactile experience. Gather spherical objects such as peas, marbles, ping pong, tennis and hand balls.

Using the approximate ratios given in Activity I, choose a different size sphere to represent each planet. Label each sphere with the name of the planet it represents.

ACTIVITY II (cont'd)

If you make a 1 cm bead Planet Earth, Uranus might be a 3 cm. ping pong ball. The sun may be represented by a large beach ball.

ACTIVITY III

Look up the distances between the planets. Set the distance from the sun to Pluto at 100 cm. Calculate the relative distance from the sun to the other planets.

Draw a straight line 100 cm across the blackboard, marking off where the planets should be.

If the distance from the sun to Pluto is about 5900 million km (scaled to 100 cm), what is the distance from the sun to the Earth? To each of the remaining planets?

ACTIVITY IV

Find out the number of years it takes each planet to revolve around the sun. Make 1 year equivalent to 1 minute.

Calculate the number of minutes it will take each planet to complete its orbit around the sun.

Have one student stand in the middle of a circle 5 m in diameter. This student will be the sun. Choose 9 other students to represent the planets. The planets will line up about 1/2 m apart next to the sun in order of their distance from the sun.

Each planet should walk in a circle around the sun and complete this orbit in the number of minutes calculated above.

How many minutes does it take Mars to orbit the sun? What does the motion of the planets and the sun look like from Earth?

ACTIVITY V

Get a feeling for distances and sizes in the solar system by setting up a scale model with ringside seats!

You'll need a large area -- a football field about 100 m in length is ideal. Use the labeled spheres in Activity III for the planets. At one end of the field (the endline), place the large beach ball representing the sun. 100 m away from the sun, place the sphere representing Earth. The moon should be about 24 cm from the Earth. Mercury should be 40 m from the sun, and Venus should be 80 m from the sun.

This model shows the relation of the size of the sun's closest neighbors to their distance from the sun.

Based upon the actual distance from the sun to Mars (Activity I), where should Mars be placed on the field?

A MOTION IN THE HEAVENS

Although Copernicus' model of the universe was simpler than Ptolemy's model, the rest of the world was not ready to leave the center of the universe. This new theory contradicted the teachings of the Church and conflicted with the strong belief in astrology still held by most people. These new views may have cost Copernicus his life had he lived long after seeing them in print.

Soon after Copernicus' death, a Danish astronomer by the name of Tycho Brahe began making detailed and accurate measurements of the positions of the planets. Brahe disagreed with Copernicus' views. He believed that only two planets, Mercury and Venus, revolved around the sun. The sun and all the other planets revolved around the Earth.

In 1600, Johann Kepler became Brahe's assistant. While Kepler admired Brahe's accurate calculations, he did not support Brahe's theory that only two planets orbited the sun. Like Copernicus, Kepler believed that the sun was the stationary center of the universe and that all the planets, including Earth, travelled in perfect circles around it. Kepler set out to plot the path of Mars using Brahe's measurements. After eight years of work, he discovered that this orbit was elliptical -- not circular. He then plotted the orbits of all the known planets. Each one followed an elliptical orbit around the sun.

In 1609, the Italian astronomer Galileo heard that the great lens makers of Holland had invented a telescope using two lenses. He immediately set out to improve upon it and built the best refracting telescopes of his day. *(Build a better telescope than Galileo's...see page 4.)*

When Galileo peered through his "optick tube," he was amazed by what he saw. The moon was no hunk of cheese or jolly old man. It was dotted with craters, mountains and valleys. The sun had spots on it. The heavens were not perfect!

Galileo also saw moons circling around Jupiter much the way our moon circles the Earth. He observed Venus passing through phases as our moon does. What he saw convinced him of Copernicus' sun-centered universe. *(See page 4 for models of the Earth and Moon and the phases of the moon.)*

The controversy Galileo aroused after publishing his findings ended with his death in an Italian prison in 1642.

1642 also marked the birth of one of the world's greatest scientists, Isaac Newton. As a boy, Newton did not appear to be a particularly bright student. He also showed no inclination to follow his father's footsteps by taking over the family farm, so his mother sent him off to Cambridge. While at Cambridge, he learned Copernicus' theory of a sun-centered universe and Descartes theory that the natural motion of objects was not circular, but a straight line. Why then did the Earth and moon move in circular paths? Why did the planets suddenly appear to move backwards? Why didn't the moon travel in a straight line out into space if that was the law of natural motion? What force held the moon high up over the Earth?

While on vacation, Newton sat under a tree pondering these questions. An apple fell at his feet. Suddenly it struck him -- could the same force that gave the apple weight and caused it to fall to the ground cause the heavenly bodies to move the way they did?

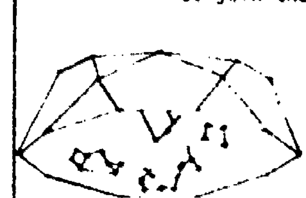
Newton set out to calculate the force the Earth exerts over objects close to it. He then figured the force exerted on the moon was 1/3600 as strong as the force exerted on the falling apple. The Moon follows a circular path around the Earth because as it falls down to Earth, it continues to move ahead in a straight line. The balance between falling and moving ahead in a straight line results in a circular orbit.

Newton called this force *gravity*. The more mass an object has, the more gravity it exerts. Even the smallest object imaginable exerts a force on objects close to it. According to Newton, gravity holds the universe together and keeps heavenly bodies from spinning off endlessly off into space.

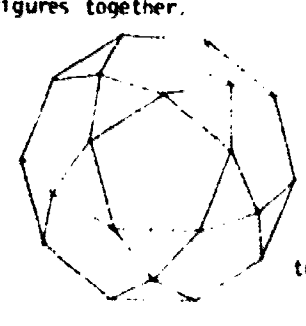
HEAVENLY DIRECTIONS

BUILDING A PLANETARIUM/CONSTELLARIUM DOME

You will need a piece of corrugated cardboard large enough to cut 11 1m X 1m squares. As seen from the top view below, cut 6 pentagons from 6 of the squares and 10 equilateral triangles from five of the squares. Each side of these figures must measure 65 cm. Leave extra cardboard on each side of each figure to make tabs. The figures will be connected by fastening the sides together. Following the pattern indicated in the drawings below, use large paper fasteners to join the figures together.



bottom view



top view

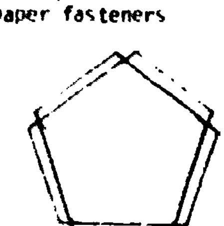


figure with tabs

BUILDING A DOME (cont'd)

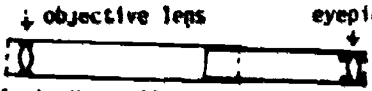
If you are lucky enough to have the money to invest in a commercial star projector, you can paint the inside of the dome with flat white paint to create a planetarium dome. Suspend the dome from the ceiling with wire.

Want your own private planetarium -- but no money for lighting up the stars? Upon request, Project City Science will send complete instructions for building a tin can star projector. Mail requests to Citiscience Notes c/o Project City Science (address below).

If you prefer a permanent view of popular constellations in your area, paint the inside of the dome with flat black paint. Once the paint has dried, use flat white paint to draw models of the constel!ations. Susepnd the dome from the ceiling with wire.

The Planetarium/Constellarium Dome can be easily taken apart and stored at the end of the term.

BUILDING A REFRACTING TELESCOPE



Build a better telescope than Galileo! You will need two cardboard tubes. One of the tubes should fit snugly into the second tube.

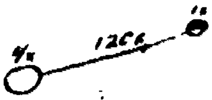
The tube holding the eyepiece should be about 10 cm. long. A linen tester or stamp magnifier can be used as a lens *(see "Where to Buy")*. The focal length measures 2-3 cm.

Cut a hole in a piece of lab cork large enough to insert the eyepiece lens. Insert the cork into one end of the smaller tube.

Fit the objective lens *(achromatic double convex lens -- see "Where to Buy")* into one end of the larger tube. This tube will measure about 20 cm. Secure the rim of the lens to the opening with clay. Have students practice focusing the telescope before using it in astronomy activities.

NEVER LOOK DIRECTLY AT THE SUN WITH THE UNAIDED EYE OR WITH A MAGNIFYING DEVICE!!!

BUILDING AN EARTH-MOON MODEL



This model can be used to simulate the phases of the moon as seen from Earth.

The diameter of the Earth (12,800 km) is 4X the diameter of the Moon (3,200 km). Use the Earth and moon spheres chosen for Activity II. Use clay to attach these two bodies to a stick 30 "Earth diameters" apart. For example, if Earth is a ping pong ba'l of 4 cm, moon can be a pea or bead 1 cm. The two will be attached to a stick about 120 cm apart from each other.

If you use a large 3 cm marble for Earth, what size sphere will you need for the moon? How far apart should they be?

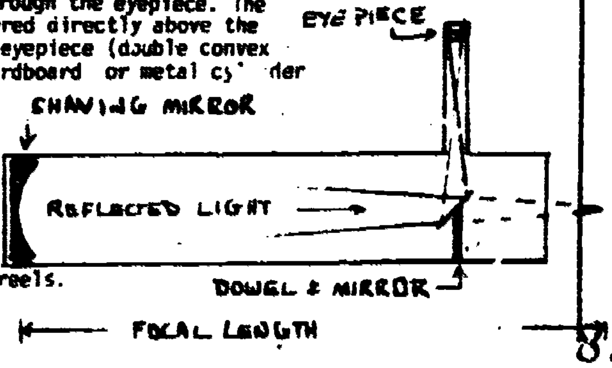
With light from a slide projector, flashlight or the sun, students can explore positions and shapes of daytime and nighttime moons as well as eclipses. Students may draw pictures of the shadows they see to compare ideas as well as to record

BUILDING A REFLECTING TELESCOPE

Newton also worked with lenses and invented the reflecting telescope. You can build one too.

Obtain a concave shaving mirror. Some distortions will appear due to surface imperfections. Determine the mirror's focal point by reflecting sunlight on white paper until a sharp image appears. The distance from lens to paper is the focal length of the lens. Fit the mirror into 1.5m or 1.75 m long circular cardboard packing tube. Set a 1' X 1' plane mirror on a 45° angle on a dowel or still wire (see drawing below). Place the mirror a short distance in front of the focal point. The 45° angle allows light to be reflected through the eyepiece. The eyepiece should be centered directly above the plane mirror. Place the eyepiece (double convex magnifying lens) in a cardboard or metal cylinder and insert it into the opening directly above the plane mirror. Raise or lower the eyepiece to magnify the image formed by the mirror.

Make a telescope holder from wood or empty wire reels.



WHERE TO GO...

The Rutherford Observatory, Columbia University
The public is invited to an open house the first Friday of each month from sunset to about 10 p.m. You will be able to gaze at the stars from the roof of the Pupin Physics Building through the University's 12" refracting telescope. Requests for tickets should be addressed to the Astronomy Department, Columbia University, New York, NY [illegible].

Brooklyn College Observatory, Ingersoll Hall
Visitors are invited Tuesday and Thursday nights, [illegible] p.m., to stargaze through a 7" refractor. If the weatherman predicts a clear night and you're interested, telephone 780-5678 in advance.

Amateur Astronomers Association, The Hayden Planetarium
Celebrate the stars on April 18, May 30, June [illegible], July [illegible], August 29, September 26, and October 24 at the Hayden Planetarium. Public star parties are given in front of the planetarium by the Amateur Astronomers Association. For more info, write the Amateur Astronomers Association, Room 602, 21 West 86 Street, NY 10024.

WHAT TO READ...

...BOOKS

Star Maps for Beginners, I. M. Levitt and Roy K. Marshall, Simon and Shuster, 1964. *For the beginner, a set of sky maps for each month including only the brighter stars easily seen with the naked eye.*

Olcott's Field Book of the Skies, William T. Olcott, revised by R. N. Mayall and M. W. Mayall, G.P. Putnam's Sons, New York, 1956. *Comprehensive guide to each constellation including myth lore and observation with the unaided eye and binoculars.*

Stars, A Guide to the Constellations, Sun, Moon, Planets and Other Features of the Heavens, Herbert S. Zim and Robert H. Baker, Golden Press, 1956. *Lots of pictures...for beginners.*

The Friendly Stars, Martha Evans Martin, revised by Donald H. Menzel and William W. Morgan, Dover, 1964. *Easy-to-read introduction for the beginner sky interpreter.*

...MAGAZINES

Astronomy *Full color, all-[illegible] magazine for the novice astronomer. $15.00 per year.* AstroMedia Corp.

Odyssey *New astronomical magazine for children. [illegible] yearly.* AstroMedia Corp. *To order or receive more information on these two publications, write the AstroMedia Corporation, 411 East Mason Street, 6th Floor, Milwaukee, Wisconsin, 53202.*

Sky and Telescope *For the advanced amateur and those interested in buying/building telescopes or observatories. $[illegible] yearly. Write Sky and Telescope, 49 Bay State Road, Cambridge, Massachusetts, [illegible].*

WHERE TO BUY...

Edmund Scientific Company, Barrington, New Jersey
Need a simple lens, a 4 1/4" reflecting telescope? Write to Edmund Scientific for a catalog listing all their scientific wares and prices.

WHOM TO CALL...

Have a quick question? Want to conduct an astronomy workshop or night sky session? Get in... with the experts...

Mark R. Chartrand, Hayden Planetarium, New York, NY 10024. 212-873-1300 Ext. 390.

K. L. Franklin, American Museum of Natural History, Hayden Planetarium, *(see address above)*. 212-873-1300 Ext. 307

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